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RANGE IMPROVEMENT



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VOL. 15, NO. 4

NOTES

OCTOBER 1970

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FOREST SERVICE — U. S. DEPARTMENT OF AGRICULTURE
INTERMOUNTAIN REGION — OGDEN, UTAH



STATEMENT OF PURPOSE

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THE STATUS OF ANTELOPE BITTERBRUSH
IN THE CASSIA MOUNTAIN AREA OF SOUTHERN IDAHO

By

T. A. Phillips*

Antelope bitterbrush (Purshia tridentata) is one of the most widely distributed of all western shrubs. According to Hormay (1943), it extends over about 340 million acres in the western states. It grows on a wide variety of sites over a wide elevation range and is one of the dominant browse plants in many plant communities. Bitterbrush produces highly palatable and nutritious forage for both domestic livestock and big-game animals. Because of its high protein content, it is especially valuable during fall and winter months when other plants often lack this essential food element. One of the outstanding characteristics of bitterbrush is its ability to withstand heavy grazing over long periods of time.

In southern Idaho, inadequate reproduction and high mortality on bitterbrush have been noted during the past 15 to 20 years. During the past 12 years, several studies relating to these problems have been conducted on Cassia Mountain, one of five units of the Sawtooth National Forest located in extreme southern Idaho and northern Utah. Excellent stands of bitterbrush occur on this area, and study information obtained here should be applicable in other areas of southern Idaho, northern Nevada, and northern Utah.

In 1962, a rather intensive age-form class study was conducted on the bitterbrush stand of the Cassia Division. This study showed that less than one percent of the bitterbrush plants was seedlings, five percent was young, 65 percent was mature, and 30 percent was decadent.

In order to obtain a more precise measure of age distribution, a ring count study was made in 1969. In this study, ten bitterbrush plants were selected at random from 20 locations on Cassia Mountain for a total sample of 200 plants. The 20 locations were on four general sites: toe slopes, canyon slopes, canyon rims, and ridgetops. Toe slopes are characterized by deep alluvial soils on gentle slopes. Bitterbrush stands on these sites are generally dense, and individual plants are large. Soil depth varies widely on the canyon slope sites, and the bitterbrush stands are more open and the plants are smaller than on the toe slope sites. The canyon rim sites are characterized by shallow soils over fractured bedrock. Good stands of bitterbrush occur on these sites, and dense stands with large individual plants are the rule. Plants on the rim sites averaged about ten years older than plants on the other sites. This is because rim sites afford greater protection from fire than do the other sites. Ridgetop sites have shallow to moderately deep soil profiles over fractured

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bedrock. Some of the best and some of the poorest stands of bitterbrush occur on these sites, depending upon soil depth and degree of fracturing in the bedrock. Soils on all sites are derived from igneous rock, mostly welded tuffs and rhyolite.

The age distribution of the 200-plant sample, plotted by 5-year class intervals, is shown on Figure 1. Age ranged from 4 to 130 years and averaged 45 years. The median age was 43.25 years, and the mode was the 36- to 40-year age class. Reproduction by stem layering was evident on all sites. Eighteen percent of the sample plants had stem layers. Layering was most common on toe slope sites where 27 percent of the plants had stem layers.

Figure 1 indicates that about 15 percent of the plants in the sample established 35 to 40 years ago. Since that time, there has been a steady decline in reproduction. A high level of establishment is indicated 40 to 60 years ago. Beyond this point it is difficult to assess establishment, since mortality tends to cloud the picture. However, it appears that good establishment occurred in the 70- to 75- and the 85- to 90-year age classes.

Figure 2 shows the sample data from 1860 to 1969 plotted by year. It is evident that establishment tends to be good or bad over a series of years rather than by single years, although 1913 and 1921 are exceptions to this rule. Good establishment occurred during the period 1895 to 1901, while poor establishment resulted during 1902 to 1911 period. Again, it was good from 1928 to 1933, and has been poor since 1960.

What are the factors that determine whether establishment will be good or bad?

Certainly, precipitation is one that should be considered. Records are available at Twin Falls and Oakley, Idaho, where annual precipitation averages 9.5 and 10.2 inches, respectively. The annual precipitation for these two stations was averaged together and plotted against bitterbrush establishment for the period 1906 to 1968 (Figure 3). There was practically no correlation between precipitation and bitterbrush establishment ($r = -0.03$). There was no pattern in precipitation that would explain the steady downward trend in bitterbrush establishment that has occurred since 1921. Seedling establishment should be best during at least a 3-year period of above-average precipitation. Leader growth occurs the first year, followed by increased seed production the second year, and seedling establishment the third year. Figure 3 shows that 1911, 1921, 1929, and 1933 were years of above-average seedling establishment. The precipitation for these years, and for the two years immediately preceding, indicates one year of below-average precipitation and two years above average for 1911; the same pattern for 1921; one year above average and two years below average for 1929; and two years above average and one year far below average for 1933. Average to considerably above-average precipitation fell during the 1961-1965 period, but bitterbrush establishment was far below what could be expected with this precipitation pattern.

FIGURE 1

CASSIA BITTERBRUSH STUDY

AGE CLASS DISTRIBUTION OF 200 BITTERBRUSH

PLANTS FROM 20 SITES - CASSIA

DIVISION SAWTOOTH NATIONAL FOREST

1969

PERCENT OF
200 PLANT
SAMPLE

17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

131-135
126-130
121-125
116-120
111-115
106-110
101-105
96-100
91-95
86-90
81-85
76-80
71-75
66-70
61-65
56-60
51-55
46-50
41-45
36-40
31-35
26-30
21-25
16-20
11-15
6-10
0-5

FIGURE 2

CASSIA BITTERBRUSH STUDY
BITTERBRUSH AGE DISTRIBUTION BY YEAR
1860-1969
200 PLANT SAMPLE

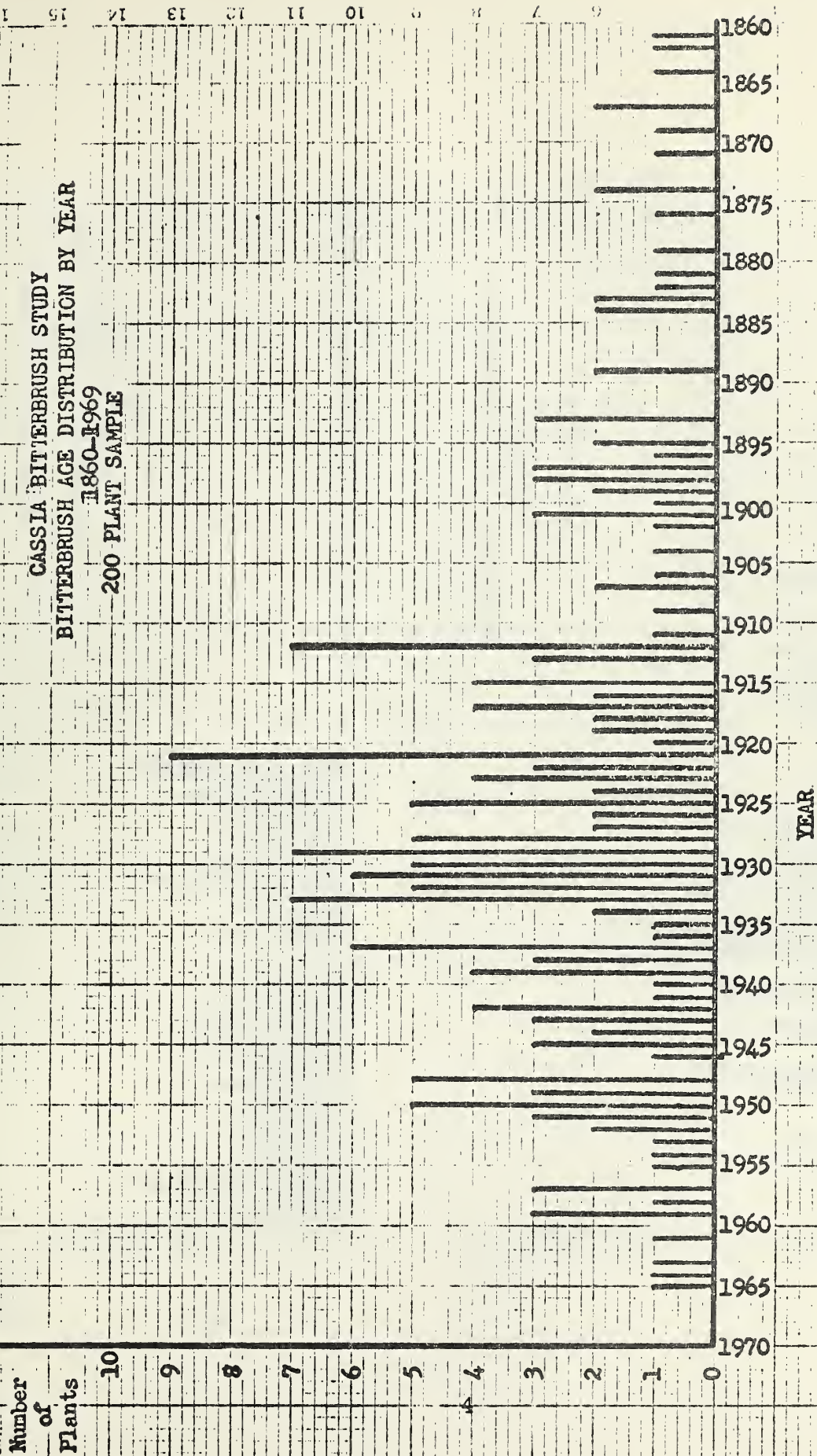


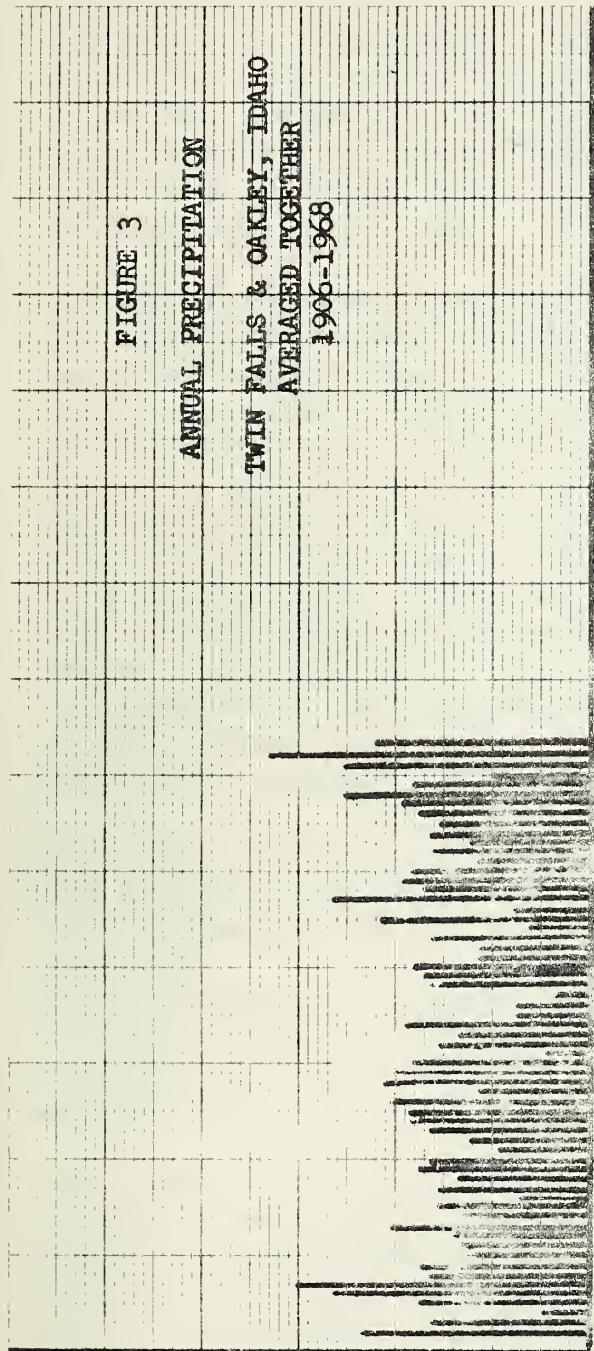
FIGURE 3

ANNUAL PRECIPITATION

TWIN FALLS & OAKLEY, IDAHO
AVERAGED TOGETHER
1906-1968

Annual
Precip.
Inches

18
16
14
12
10
8



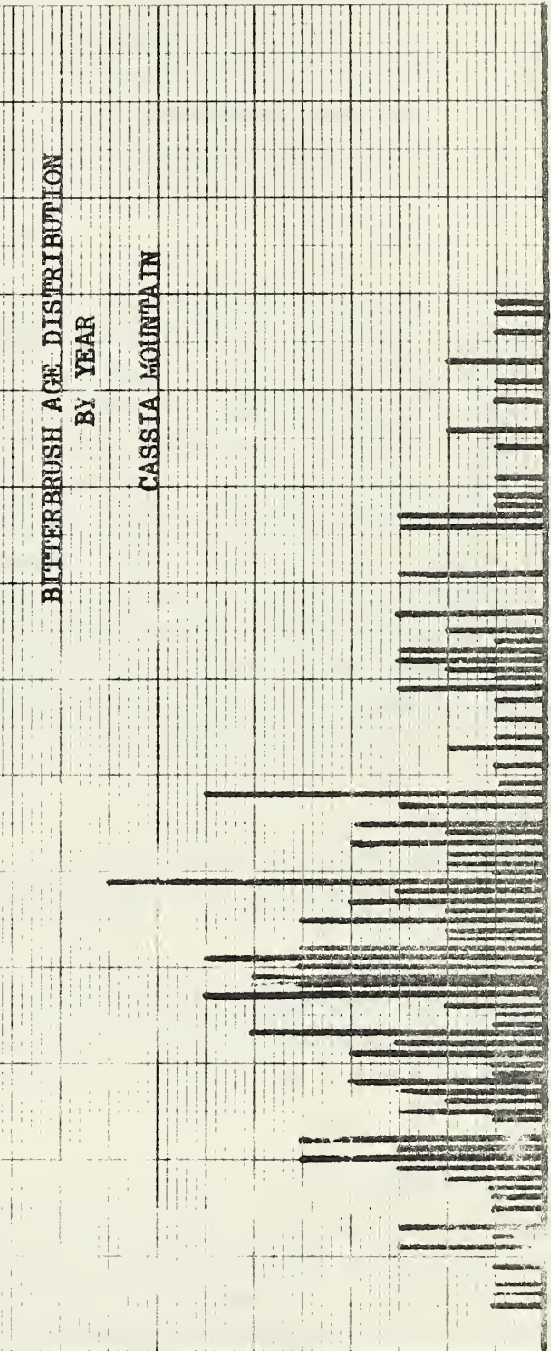
BUTTERBRUSH AGE DISTRIBUTION

BY YEAR

CASSIA MOUNTAIN

No. of
Plants

9
8
7
6
5
4
3
2
1
0



1860
1865
1870
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970

Fairly good establishment occurred during the 1948-1951 period, even though precipitation was average to considerably below average for the period. In view of these anomalies, it is apparent that bitterbrush establishment is influenced by factors other than precipitation.

Grazing, both by domestic livestock and big-game animals, undoubtedly, influences bitterbrush establishment to some extent. Stocking records for the old Minidoka Forest, which included the Cassia Mountain, are shown plotted against bitterbrush establishment dates in Figure 4. While stocking records are for the entire Minidoka Forest, the indicated trend in numbers and relative stocking rate are applicable to the Cassia Division. Livestock numbers were converted to animal unit by converting sheep numbers to cattle on a 5-to-1 ratio and adding cattle numbers to this total.

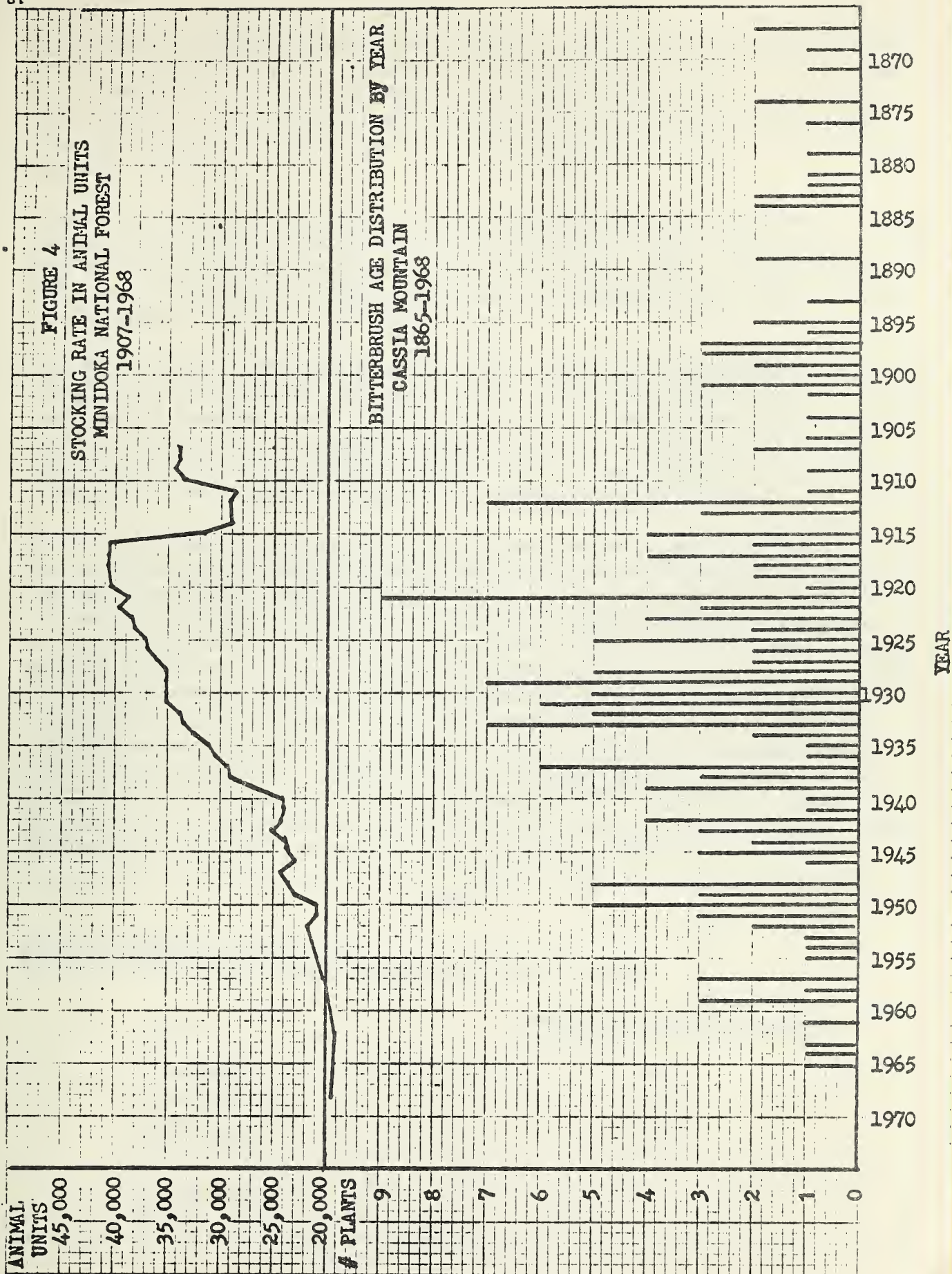
Stocking records are not available beyond 1907, but historical records indicate that cattle first grazed in the Cassia Mountain area in 1871. Cattle numbers increased rapidly during the next ten to fifteen years, as large cattle outfits from Texas moved into the area. By the early 1880's, the area was being severely overgrazed. Drouth, followed by severe winters in 1886 and 1889, resulted in a tremendous reduction in cattle numbers. Several large cattle outfits were wiped out during these years when cattle either starved or froze to death on the winter range. Sheep first entered the area in 1891, following the drastic reduction in cattle numbers, and increased rapidly until about 1895. In that year, 85,000 sheep were dipped at a single dipping vat near Bostetter Ranger Station on the Cassia Mountain. Sheep numbers remained near the 1895 high until the Minidoka National Forest was established in 1905. Cattle numbers increased, from the low of 1890 to 60 to 70 percent of the mid-1880 high, and remained at this level until 1905.

From the historical record, it is logical to assume that the Cassia Mountain area received extremely heavy grazing use for some 30 to 35 years prior to the establishment of the Minidoka National Forest.

Figure 4 indicates that livestock numbers decreased sharply for a few years following 1905 but then increased during World War I. From 1920 until 1950, numbers steadily declined. Since 1950, there has been little change in the stocking level.

It is evident that bitterbrush was able to reproduce and establish itself under extremely heavy grazing pressure. Good establishment occurred during the period from 1895 to 1902, at a time when both sheep and cattle numbers were at a high level. There is no indication that the sharp reduction in cattle numbers that occurred in 1886, and again in 1889 increased bitterbrush establishment. In fact, establishment appears to have been rather low during the 1885-1890 period.

It is also evident that the trend in bitterbrush establishment closely follows the downward trend in livestock numbers that has occurred since about 1920. Since



bitterbrush is a pioneer plant on many sites, it could be that bitterbrush establishment is favored by heavy grazing. Heavy grazing would favor bitterbrush by increasing bare soil and by reducing competition from other plants--especially grass. As grazing pressure declines, ground cover increases along with competition from other species, thus making it more difficult for bitterbrush to establish.

Game use may also be a factor that influences bitterbrush establishment. Deer numbers were at a low ebb on the Cassia Mountain for many years prior to 1920. The deer population then increased rapidly until about 1950. During the late 1940's and early 1950's, bitterbrush received extremely heavy use both on the summer range as well as the winter range.

During the 1950's, the Idaho Fish and Game Department carried out an intensive reduction campaign on the Cassia deer herd. This has greatly reduced the grazing pressure on bitterbrush. During the past ten years, use on the browse transects on the unit has averaged less than 30 percent. Figure 5 shows annual trend count numbers for deer since 1944. Again, the downward trend in deer numbers closely parallels the trend in bitterbrush establishment.

Rodents aid in establishing bitterbrush by planting seed. On the other hand, they consume large quantities of seed and directly damage bitterbrush by girdling plants at the root crown. Extensive root crown damage has occurred on the Cassia Mountain during the past 12 years. Mouse population explosions have occurred three times during this period--1958, 1963, and 1968. Damage surveys conducted, following the 1958 and 1963 irruptions, indicated that from 10 to 20 percent of the plants in some stands along the north and west side of the mountain had been killed. The 1968 irruption appears to have been less severe than the previous ones, and much of the damage was on sagebrush rather than bitterbrush. Extensive root crown damage was indicated on the plants selected for the age class study made in 1969. Thirty-eight percent of the plants in the age study sample showed mouse damage to some extent. The percent of plants damaged varied widely by site as indicated in Table 1.

Table 1

Mouse damage to bitterbrush

Percent of 200-plant sample showing root crown damage

<u>Site</u>	<u>Percent of Plants Damaged</u>
Toe Slopes	57
Canyon Slopes	32
Ridgetops	29
Canyon Rims	57
Average All Sites	38

DEER

COUNTED

7000
6000
5000
4000
3000
2000
1000

FIGURE 5

CASSIA UNIT DEER TREND COUNTS

1944-1969



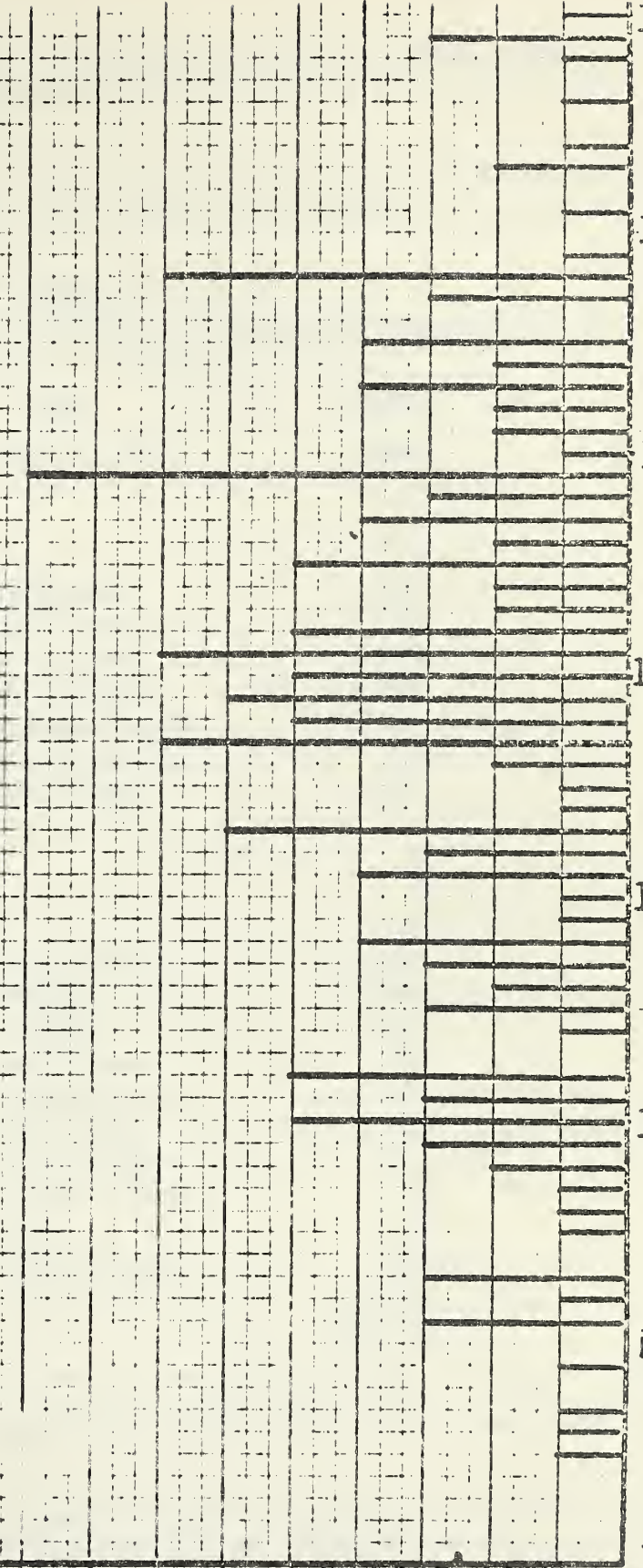
NO. PLANTS

ESTABLISHED

9
8
7
6
5
4
3
2
1
0

CASSIA UNIT NUMBER OF BITTERBRUSH PLANTS

ESTABLISHED BY DATE



YEAR

1900

1910

1920

1930

1940

1950

1960

1970

Mouse damage was most extensive in old stands and where ground cover was heaviest. Bitterbrush stands on toe slopes and canyon rims most often have these characteristics.

Fire has, undoubtedly, killed more bitterbrush on the Cassia Mountain than all other destructive agents combined. The extent of fire damage is indicated in Table 2.

Table 2

Acreage burned on the Cassia Division, Sawtooth National Forest 1953-1969

<u>Year</u>	<u>Fire</u>	<u>Acres</u>
1953	Goose Creek	1, 050
1954		0
1955		0
1956		0
1957	McMullen	4, 780
1958	Jay Creek	263
1959	Dry Creek	1, 235
1960	Dry Creek	14, 000
1960	Hoopes Drive	29
1960	Camp Spring	35
1961	Dry Creek	1, 700
1962		0
1963		0
1964		0
1965		0
1966	Goat Spring	1, 030
1966	Magic	74, 000
1966	4-Mile	3, 150
1966	Big Cedar	475
1966	Badger Gulch	50
1966	Ibex Peak	135
1966	Lone Cedar	20
1966	Johnny Canyon	60
1967	Noh	20
1968	Cottonwood	225
1969	Willow Creek	53
TOTAL		102, 310

Bitterbrush was probably growing on at least 80 percent of the area shown in Table 2.

Inspections made on these burns reveal that little or no bitterbrush is being established, either from seed or from resprouting. Studies were made on five burns to determine resprouting. As the bitterbrush plants were examined, they were rated as to degree of burn--light, moderate, and heavy. On lightly

burned plants, fire had removed the leaves and smaller terminal branches. On moderately burned plants, larger branches were consumed, leaving only the primary stems unburned. Heavily burned plants were burned to ground level or had only one or two primary branches, less than 1-1/2 feet tall, left standing. The results of surveys on five burns are shown in Table 3.

Table 3

Percentage of Bitterbrush plants resprouting following light, moderate, and heavy burns

<u>Fire</u>	<u>Degree of Burn</u>		
	<u>Light</u>	<u>Moderate</u>	<u>Heavy</u>
Goat Spring	15	5	0
Magic	41	7	0
McMullen	10	-	0
Dry Creek	17	-	-
Dry Creek	<u>3</u>	<u>-</u>	<u>0</u>
Average	17	6	0

Significant resprouting occurred only on the lightly burned plants, and the sprouting percentage had an extremely wide range--3 to 41 percent. Since these fires were extremely hot over most of the burned acreage, there is little chance that bitterbrush stands will reestablish by sprouting.

There is evidence that date of burn is important in determining the extent of resprouting following fire. The Goat Spring fire occurred on July 1, 1966, while the Magic fire started on August 25 of the same year. The Magic fire burned to the perimeter of the Goat Spring fire. Resprouting studies on the two burns were conducted on areas about 300 yards apart on similar sites.

Table 3 shows that 41 percent of the lightly burned bitterbrush plants sprouted on the Magic burn, as compared to only 15 percent on the Goat Spring burn. This difference is probably due to better food storage in the roots of the plants burned in August.

The general practice has been to seed the less steep burned areas during the fall months following the fire. The steeper areas are left untreated, and these are, generally, invaded by cheatgrass brome (Bromus tectorum).

Reinvasion by browse species, generally, begins on the burned areas within a few years following the fire. Studies were made on three burns to determine which browse species were invading the burns and the relative density of each species in the stand. Two of the study areas were seeded and one was not seeded. The data from the studies are summarized in Table 4.

Table 4
Browse reestablishment four years following fire on seeded and unseeded burns

	Number of Plants Per Acre		
	<u>Sagebrush</u>	<u>Bitterbrush</u>	<u>Yellowbrush</u>
Heavy Burn--Seeded to crested wheatgrass, production 950 lbs/A.	740	20	1560
Heavy Burn--Seeded to crested wheatgrass, production 1600 lbs/A.	30	0	100
Light Burn--Not seeded	<u>730</u>	<u>110</u>	<u>210</u>
Average	500	43	620

Table 4 indicates that both sagebrush and yellowbrush are much more aggressive than bitterbrush in establishing on burned areas. It also indicates that establishment is much more rapid in less dense crested wheatgrass stands and on areas that are not seeded. Full stands of crested wheatgrass appear to be highly resistant to invasion by browse species. Yellowbrush (*Chrysothamnus viscidiflorus*) sprouts profusely following fire, and is thus never eliminated from burned areas. Sagebrush, on the other hand, is even more susceptible to fire than bitterbrush. Since it is a prolific seeder, it is able to invade rapidly from adjacent unburned sagebrush stands. Practically all of the bitterbrush that has established on burned areas has resulted from resprouting rather than from seed. The reasons why bitterbrush does not invade burned areas from adjacent unburned stands are not clear. It may be that there are not enough rodents to plant the seed, or that competition from cheatgrass or native forbs and grasses prevents establishment. In any event, it appears that bitterbrush will be a minor component of any browse stands that establish on burned areas.

The studies conducted to date on the Cassia Mountain area indicate a dark future for bitterbrush, since there is inadequate reproduction, high mortality, and inadequate reestablishment on burned areas. If this valuable plant is to be maintained, it will have to be done by artificial means.

Reserach has shown that good stands of bitterbrush can be established with either seed or transplants. Several trial plantings have been made on the Sawtooth National Forest during the past five years with, generally, encouraging results. In 1965, six plantings of bitterbrush, cliffrose, and desert bitterbrush were made on 2-1/2 by 2-1/2 foot scalps. The establishment and survival percentage on these plantings are shown in Table 5.

Good stands for all species and seed sources were evident by the fall of 1966. By 1969, mortality had reduced the stands 22 to 95 percent. The least mortality occurred in Fleck Summit bitterbrush, a locally grown species, and Washoe County, Nevada, bitterbrush. The Washoe County seed also produced significantly better initial stands than seed from any of the other sources. Desert

Table 5

Survival percentage on six plantings of bitterbrush, cliffrose, and desert bitterbrush, Fairfield Ranger District, Sawtooth National Forest, 1959-1969

<u>Seed Source</u>	<u>Survival Percentage*</u>				
	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>% Loss</u>
Fleck Summit bitterbrush	56	54	NC	44	22
Washoe County bitterbrush	95	88	NC	70	26
Susanville bitterbrush	72	57	NC	45	38
Mono County desert bitterbrush	82	60	13	4	95
Mono County bitterbrush	81	63	NC	53	35
Holden, Utah, cliffrose	65	17	11	5	92

*Percent of scalps with live plants.

bitterbrush and cliffrose appear to be poorly suited for this site; however, these species produced good stands on a site in Big Cedar Canyon on the east side of the Cassia Division of the Forest.

In the fall of 1967, additional plantings on Washoe County bitterbrush were made on five of the Districts on the Sawtooth National Forest. Survival for 1968 and 1969 is shown on Table 6.

Table 6

Survival counts on Washoe County bitterbrush seed planted in October 1967

<u>District</u>	<u>Location</u>	<u>Survival Percentage</u>	
		<u>1968</u>	<u>1969</u>
1	Limekiln Gulch	80	44
2	Eagle Creek	80	80
4	South Boise	84	32
6	Goat Spring	Destroyed by rabbits	
8	Lynn Pasture	68	54

Good to excellent stands established the first year after seeding. The following year around 50 percent of the plants died on two sites, but survival was very good on two other sites. Good germination was evident on the Goat Spring site, but rabbits destroyed the seedlings.

Experimental plantings using bitterbrush transplants were made at three locations on the Sawtooth National Forest in the spring of 1967. Survival for these plantings is shown for 1968 and 1969 in Table 7.

Table 7

Survival percentage on bitterbrush transplants at three locations

<u>District</u>	<u>Location</u>	<u>Survival Percentage</u>	
		<u>1968</u>	<u>1969</u>
2	Eagle Creek	60	55
4	South Boise	54	41
8	Lynn Pasture	22	No report

Considerable mortality was evident on two of the plantings, while a very heavy loss resulted on the third planting during the first year. Further loss was evident the second year but to a much lesser extent.

Mortality, in some degree, must be expected on all plantings, since there is competition among bitterbrush plants as well as from other shrubs, forbs, and grasses on the site. On the plantings noted in Table 5, good to excellent stands were still extant after four years on four of the six plantings. It is probable that reduced mortality will occur in future years, since the bitterbrush plants have had time to reach a stable balance with each other and with the rest of the vegetation in the plant community. In view of this, the chances of obtaining successful bitterbrush plantings in the southern Idaho area appear to be very good.

SUMMARY

1. Bitterbrush is one of the most important browse plants in southern Idaho. It grows on a wide variety of sites over a wide elevation range. It is a most valuable forage plant on fall and winter range, producing palatable and highly nutritious forage for both domestic livestock and big-game animals.
2. Lack of reproduction and high mortality have been noted on bitterbrush in southern Idaho for many years. Age-form class studies and age-class studies from ring counts show that about 95 percent of the plants in bitterbrush stands in the Cassia Mountain area are in the mature and decadent age groups.
3. Two hundred bitterbrush plants aged from ring counts showed an average age of 45 years and a range from 4 to 130 years. This study shows that bitterbrush tends to establish over a series of years rather than during any one particular year. Establishment has declined steadily since 1921.
4. There was no correlation between establishment and annual precipitation. Bitterbrush established as well during dry cycles as during wet cycles.

